



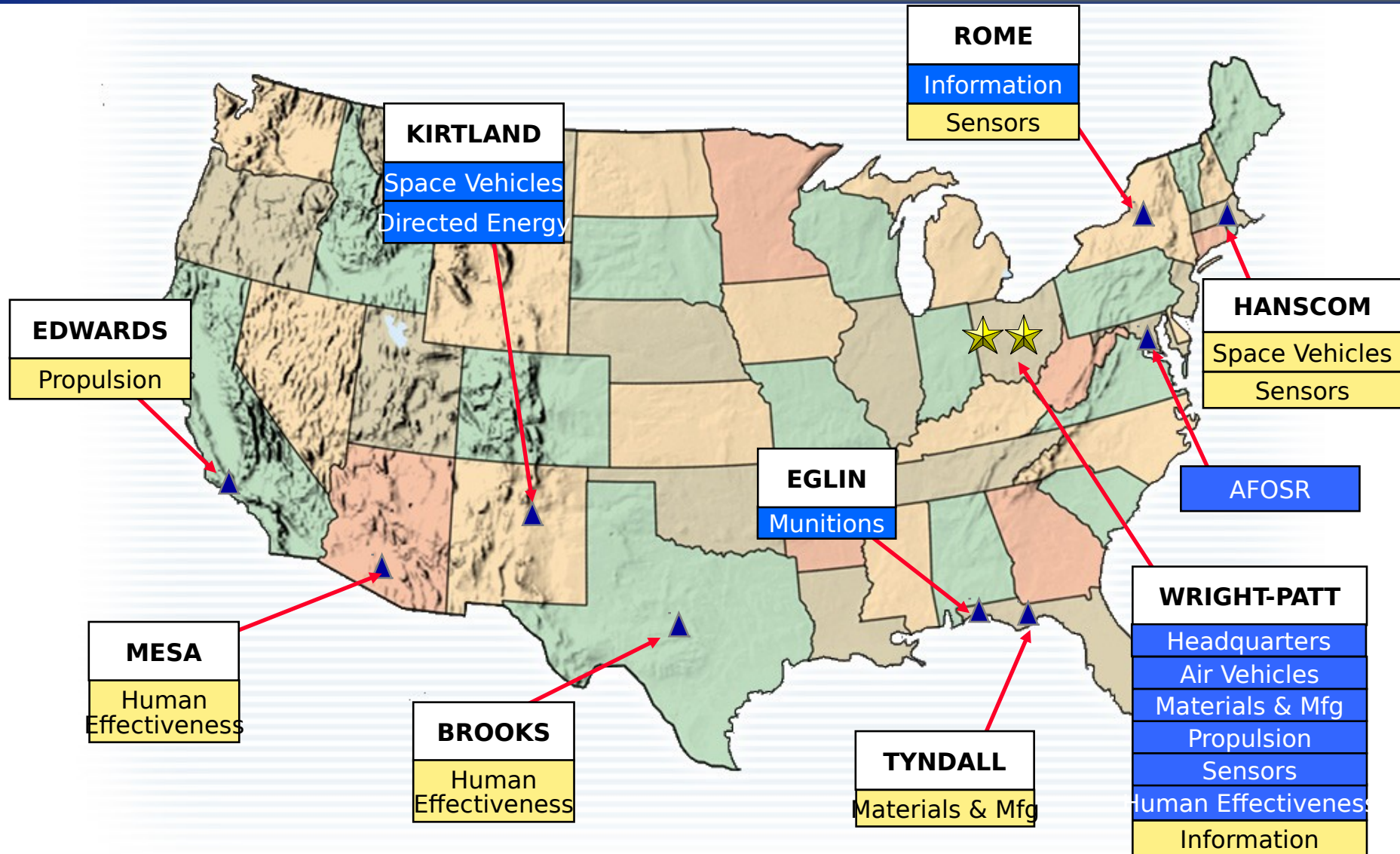
AFRL Mission

*Leading the discovery, development,
and integration of affordable
warfighting technologies for our air
and space force.*





AFRL Sites

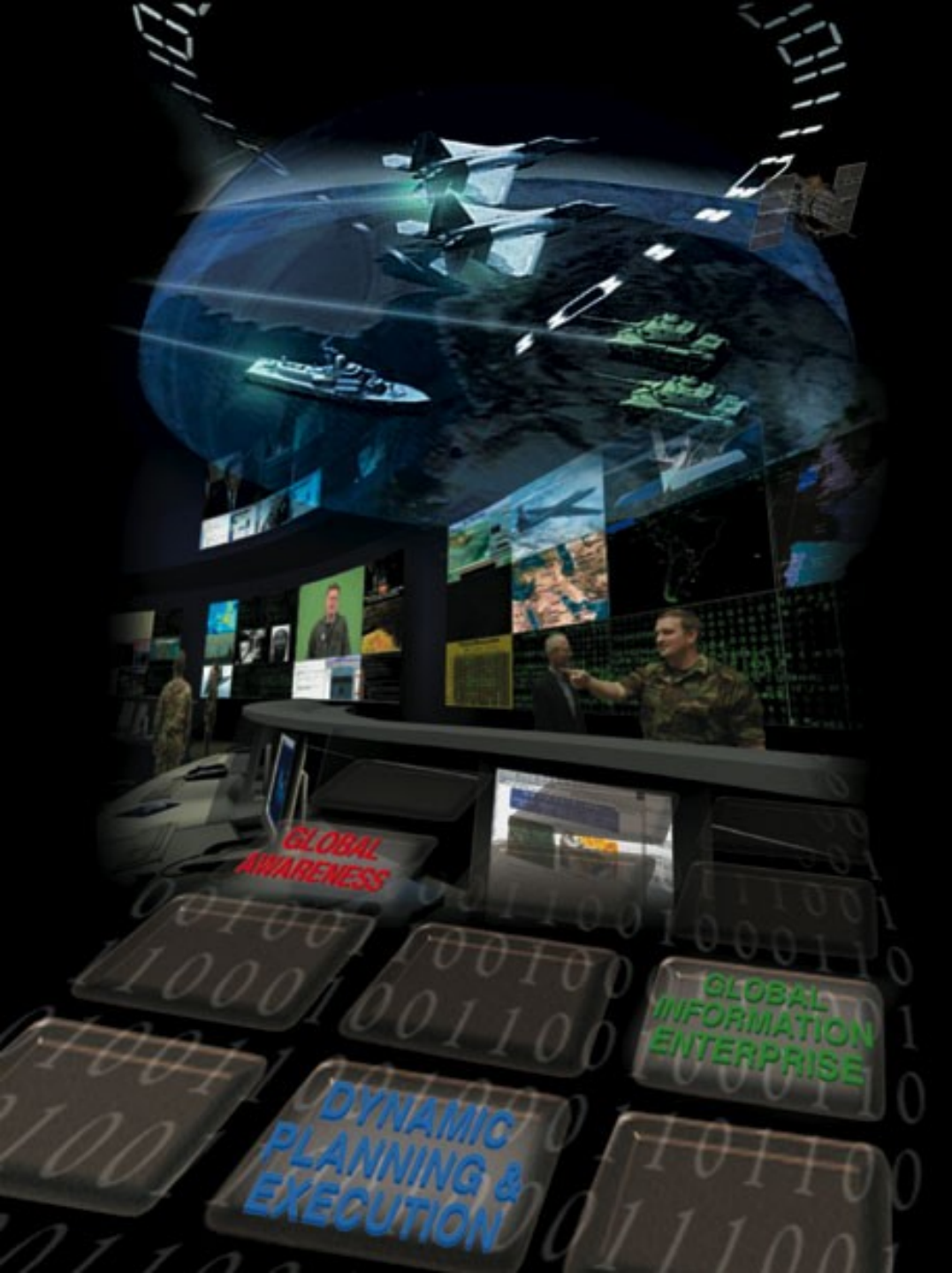




AFRL Information Directorate

Developing
Enterprise Solutions
for the Nation's
Defense

***Dr. Northrup Fowler III,
Chief Scientist***





Our Technology Heritage

C2 Increasing Emphasis



ECHO

1960
Satellite
Communica
tions



1988
Track &
ID
Fusion
Algorith

1995
Off-Board
Data



2000
TBM



1958
Space
Surveilla
nce



1968
ARPANET



Intellige
nce
Data
Handlin
g
System
s



1991
Advanc
ed
Plannin
g
System

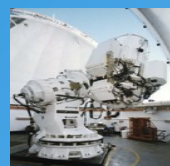


ISSE Guard
Multi-Level
Secure
Infrastructure



MTI

1968
Phas
ed



1979
SkyLab
Trackin
g

(Desert
Storm)



1980
Pave
Mover
Radar

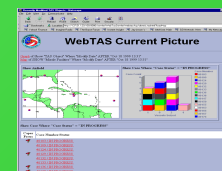
1996
Software
Programma
ble Radi



1997
BROADSWO
RD
(Kosovo)



1991
JSTARS



Radar Decreasing Emphasis

50's

60's

70's

80's

90's

2005

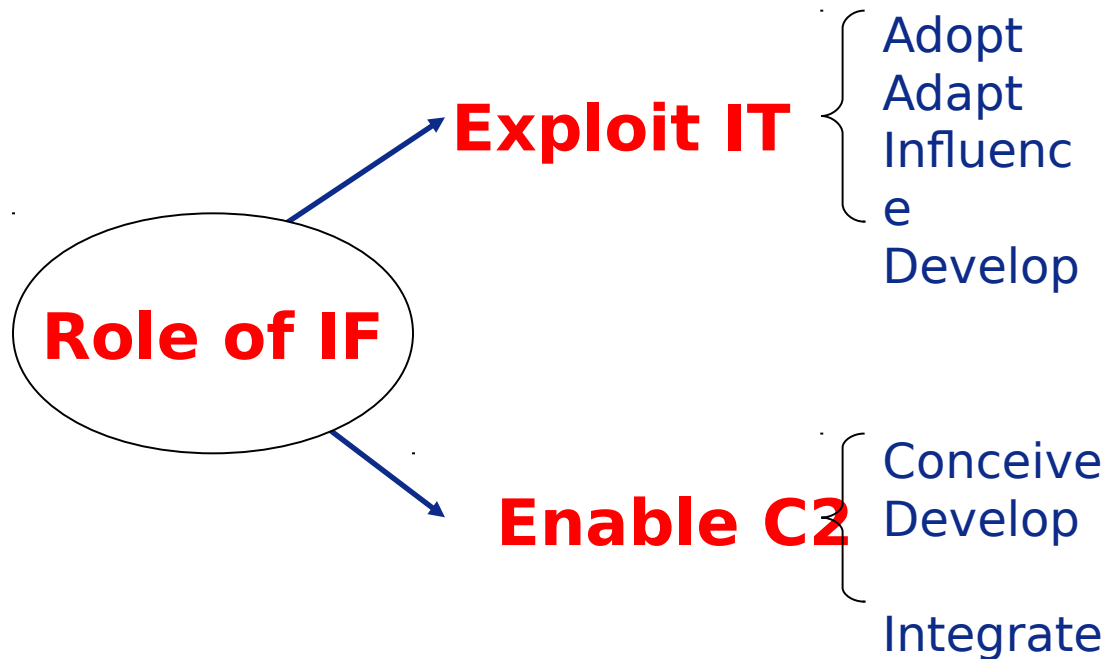


The Role of Information in Today's USAF



Information Directorate

Increased **tempo**, higher **precision**, and more **complex data** sources have increased the demand for tailored **INFORMATION** and has increased emphasis on revolutionary **INFORMATION TECHNOLOGIES**.





Capability (Task) Statements Source Information



Information Directorate

AF Master Capability Library, v5.5, dtd Nov 2004

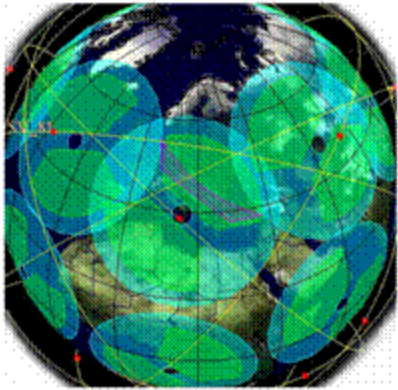
- 1. Surveillance and Reconnaissance (568)**
- 2. Intelligence (252)**
- 3. Command and Control (329)**
- 4. Provide Network-Centric Enterprise Information Environment (356)**
- 5. Force Application (900)**
- 6. Force Projection (190)**
- 7. Protect (60)**
- 8. Establish and Generate (479)**
- 9. Create and Sustain the Force (366)**



AFRL/IF Capability Based S&T Program Thrusts



Information Directorate



Global Awareness (Linked to MCL #1 & #2)

- **Acquires, exploits, fuses, and reasons over data/information**
- **Provides tailored, consistent, superior situational knowledge**
- **Sufficient precision to enable the decision process at all levels of command**

Dynamic Planning & Execution (Linked to MCL #3)

- **Rapidly exploits superior, consistent knowledge of the battlespace**
- **Faster, better informed, and more accurate decisions in complex uncertain environments - Air, Space, Surface, Cyber**
- **Shape and control the pace and phasing of engagements**



Global Information Enterprise (Linked to MCL #4)

- **Moves, processes, manages, and protects information supporting GA and DP&E throughout the global information grid**
- **Multiple military and commercial transmission media**





AFRL/IF Technology Focus Areas



Information Directorate



Information Exploitation

Information Fusion & Understanding

Information Management

Advanced Computing Architecture

Cyber Operations

Connectivity

Command & Control



Information Exploitation



Information Directorate

Information Exploitation involves the estimation and prediction of signal/feature states on the basis of pixel/signal level data association and characterization, together with the estimation and prediction of entity states on the basis of observation-to-track association, continuous state estimation (e.g. kinematics) and discrete state estimation (e.g. target type and ID)

- **Electronic Intelligence (ELINT)**
- **Communications Intelligence (COMINT)**
 - **Intercept Processing and Location**
 - **Special Signals**
 - **Audio & Speech Processing**
- **Imagery Intelligence (IMINT)**
 - **Still & Motion Imagery Exploitation**
- **Measurement & Signatures Intelligence (MASINT)**
- **Laser Intelligence (LASINT)**
- **Steganography**



Information Fusion & Understanding



Information Directorate

Information Fusion is defined as the process of combining information (in the broadest sense) to estimate or predict the state of some aspect of the universe. The process is characterized by continuous refinement of its estimates and assessments, and by evaluation of the need for additional sources, or modification of the process itself, to achieve improved results.

- **Multi-INT Fusion**
- **All Levels of Fusion**
- **Predictive Battlespace Awareness**
- **Intelligent Systems Technology**



Information Management



Information Directorate

Information management is a set of intentional activities to maximize the value of information to support the objectives of the enterprise. The challenge of IM in a military context is to **achieve the responsiveness and flexibility of the WWW with the control and predictability of traditional C2 IMS.**

- **Tailored, Actionable Information**
 - Intelligent Information Distribution
 - Semantic Content/Decision Utility
- **Universal Access to Information**
 - Joint BattleSpace Infosphere
- **Orchestrated Info Environment**
 - Collaboration, Workflow
 - Infospherics - S&T of very large-scale, complex info system design
- **Continuous Adaptation**
 - Information Quality of Service
 - Commander's Guidance/Policy



Advanced Computing Architectures



Information Directorate

The set of data types, operations, and features of each level of computer design is called its **architecture. The architecture deals with those aspects that are visible to the user of that level. (Tannenbaum)**

- **Fundamental Models of Computation**
- **Engineering Techniques for Design of Computing Systems**
 - **Advanced system hardware & software to solve computationally complex and demanding problems**
 - **Application of theory to design**
 - **High Performance Computing for C2 (Traditional and Cluster HPCs)**
 - **Embedded Platform Computing**
 - **Cognitive Computing**
 - **Biomolecular Computing**
 - **Nano-Computing**
 - **Quantum Information Science**
 - **Other (Cellular automata, Grid computing, Autonomic Computing etc)**



Cyber Operations



Information Directorate

- **Cyber Operations** is that part of Information Operations that includes the following:
 - **Cyber Defense** comprises those measures to **protect and defend information systems** by ensuring their availability, integrity, authenticity, confidentiality, and non-repudiation. Also, cyber defense includes **actions taken to plan and direct responses** to unauthorized activity in defense of AF information systems and computer networks.
 - **Cyber Attack** operations are conducted using information systems to **disrupt, deny, degrade, or destroy** information resident in computers and computer networks, or the computers and networks themselves, or military capabilities enabled by them.
 - **Cyber ISR** operations are Intelligence, Surveillance, and Reconnaissance functions in cyberspace that result in the ability to **gather information about the adversary, their intentions, and their capabilities.**



Connectivity



Information Directorate

High Capacity Communications

Integrated RF and Optical systems (e.g. Antenna apertures, Lightwave ICs)

New Waveforms (more bits/Hz, resilient, LPI)

All optical switching & routing (no O-E-O conversion)

Spectrum Utilization/Efficiency distributed real time spectrum sensing, analysis, & allocation, real time protocol composition

C2ISR Networking

Resilient Protocols for dynamic/disadvantaged environments

Multiple/diverse media (kb to Gb) Access and Control

Adaptive end to end QoS for variable bit rate connectivity

Mobile/Ad hoc – hand-offs, security, route propagation scalability

Embedded Universal Gateways & Integration with Legacy Services

Intelligent Information Routing (Content Based)

Enterprise Management & Control

Across AF, Joint, and Coalition Domains - Space, Air, and Surface elements

Policy based Military Quality of Service with dynamic bandwidth allocation



Command & Control



Information Directorate

Command & Control is the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in **planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission.** Also called **C2.** (JP 0-2)

- **Predictive Environments & Effects Based Operations**
- **Adversarial Modeling and Reasoning**
- **Mixed Initiative Decision Aiding**
- **Agile Tasking (Power to the Edge)**



Transformational Technologies



Information Directorate

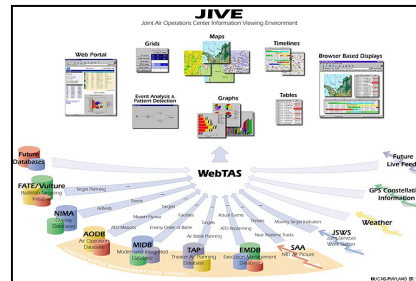
In Iraq, Afghanistan, and at home, the Information Directorate's groundbreaking technologies are revolutionizing the methods by which wars are fought and won.

Communicating vast amounts of critical, secure information to battlefield commanders in real-time



SPEAKeasy: an integrated communications capability. The US will be migrating its radio communications to "Software Defined Radios (SDR's)".

Transforming intelligence data across services into immediate strategic responses



Web-based Timeline Analysis System: temporal picture from multiple data sources and displays in common maps, timelines, and situation alerting tools.

Tracking and **preventing** emerging threats to homeland security



Moving Target Information Exploitation: Web enabled exploitation and fusion of real-time data from the battlefield

Direct Support to Iraqi Freedom and Homeland Defense



Air and Space Operations Center



Information Directorate

IF Delivery

Increased AOC Capability

Information Warfare Planning Capability	Cyber Operations
Time Critical Targeting Functionality	Improves the Target "Kill Chain"
Global Broadcast System	Provides increased communications
Communications Support Processor	Replaces AUTODIN and interim solution until Digital Messaging System (DMS) arrives
Data Wall	Advanced Visualization
ISSE Guard	Provides Multi-level Security across various domains and allows TS-S-U message transfers
Broadsword / IOTA	Consolidates user accesses via web-based interface
WebTAS	Provides timeline analysis
INTELINK and INTELINK-S	Provides intelligence networks within AOC
Theater Battle Management Core System Components	Improved process to optimize and streamline planning, scheduling and assessment applications
Predator Vide	Provides for a real-time UAV interface
Air Force DODISS Infrastructure	Provides an infrastructure similar to intelligence community
Personnel Recovery Mission Software	Provides improved search and rescue applications



Air and Space Operations Center

Capability Insertion



AFRL/IF Inside



Transformation Center

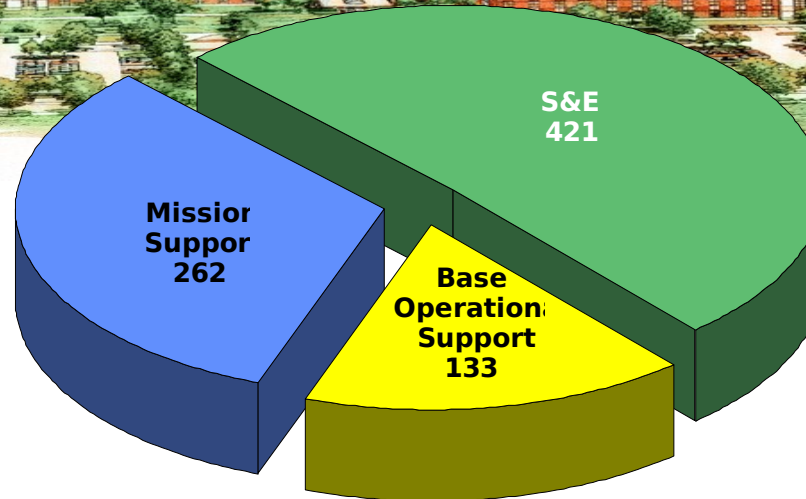


The IF Workforce

Information Directorate



Rome 737



Total Directorate Staffing

Civilian S&Es *	350
Military S&Es *	71
On-Site Collaborators S&Es	405
Information Institute and Other Academics	29
Military Support Staff *	44
Civilian Support Staff *	351
On-Site Support Contractors*	196
Total	1446

- New Hires
 - Top graduates,
 - from top universities
- 20 in '02
- 24 in '03
- 15 in '04
- 12 in 05 (Projected)
- GPAs > 3.5



AFRL/IF Military Personnel



Information Directorate

Officers

	Scientists	Engineers	Program Managers	Contracting	Comm/Computers	Intel	Other	Total
FGO	0	3	2	1	1	0	2	9
Capt	2	5	2	0	4	0	2	15
Lt	4	16	4	3	5	2	0	34
Total	6	24	8	4	10	2	4	58

Enlisted

(Various AFSCs)

Rome	
Officers	58
NCOs	24
Wright Patterson	
Officers	8
Total	94

MSgt	6
TSgt	10
SSgt	7
SrA	1
Total	24

**WX,
16R,
JAG**

Ops and Support
(e.g., SIGINT, COMINT, C2, Supply, Trans, Finance, comm/computers)

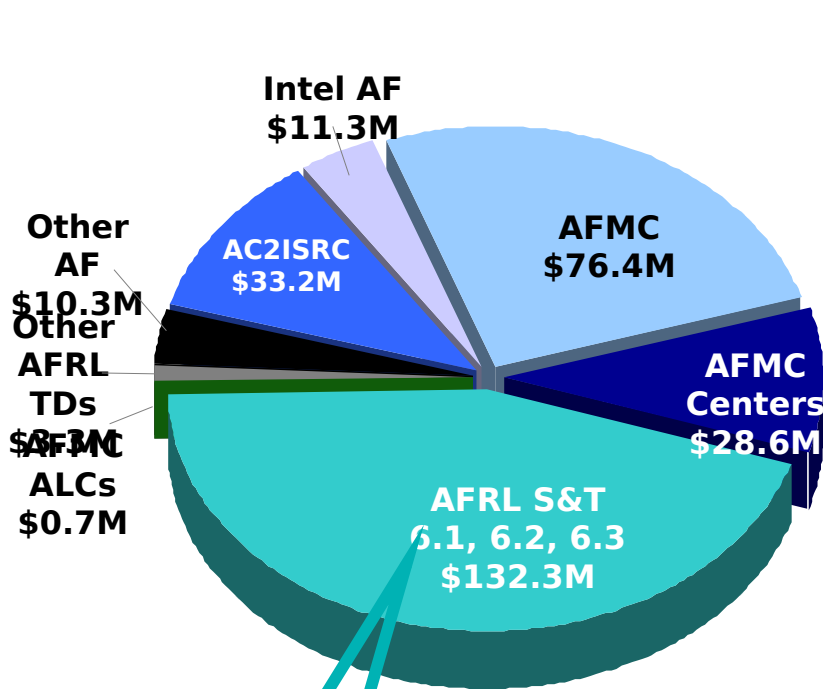
As of: 23 Mar 05



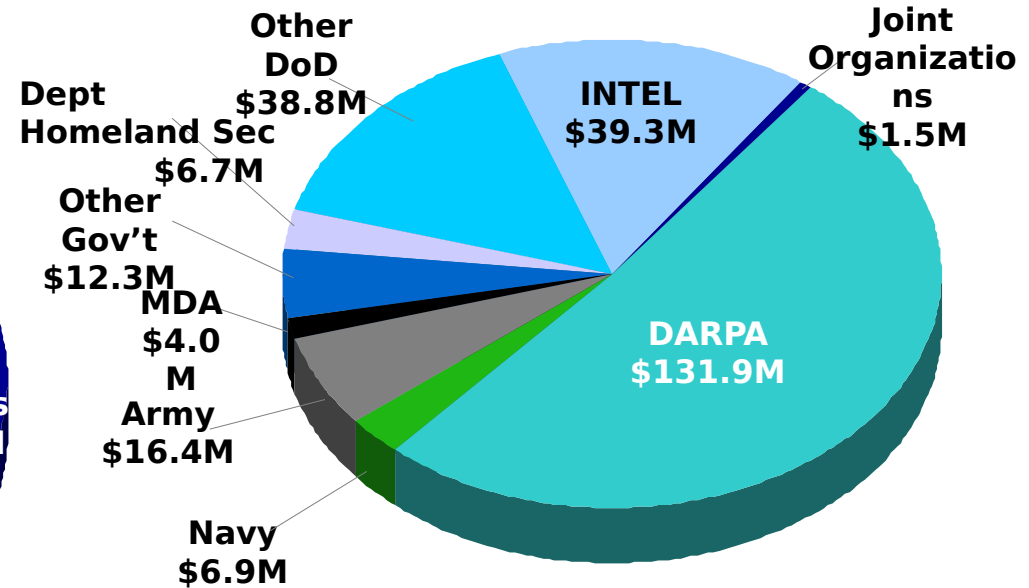
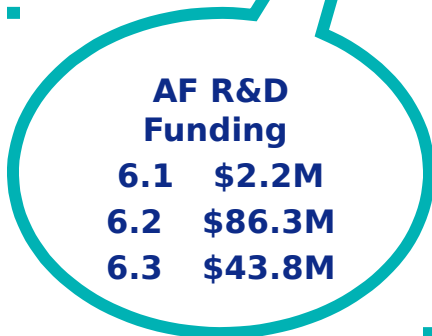
Actual IF FY 04 Funding Received



Information Directorate



**Total IF FY04
AF Funding
\$296.1M**



**Total IF FY04
Non-AF Funding
\$257.8M**

**Total AFRL/IF
\$553.9M**



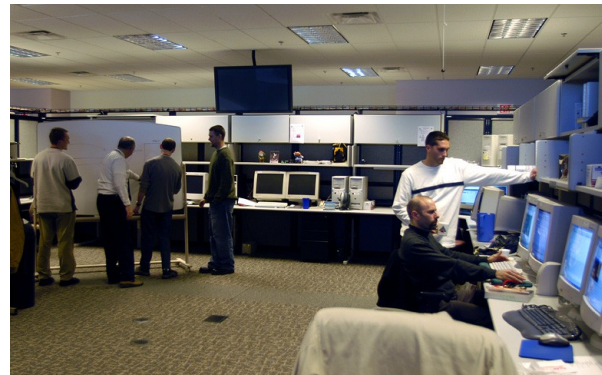
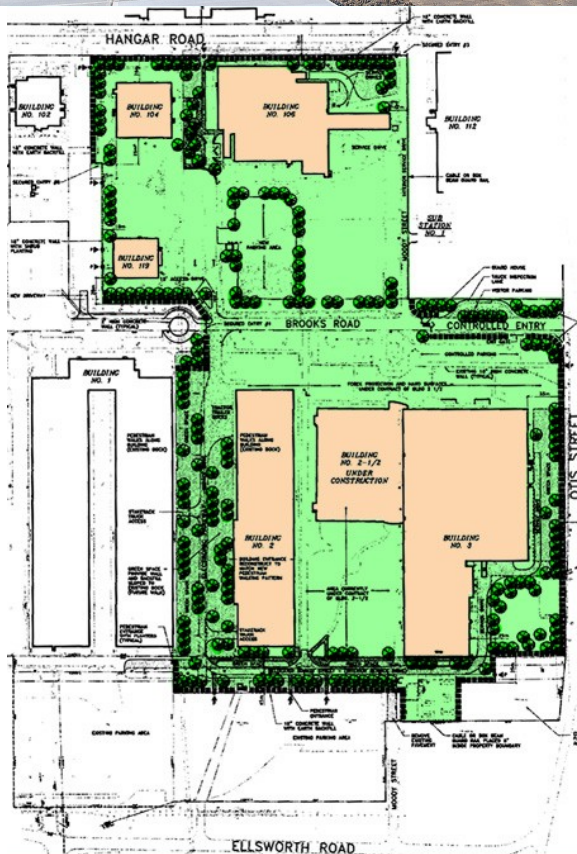
Total Revitalization of Our R&D Space

Information Directorate

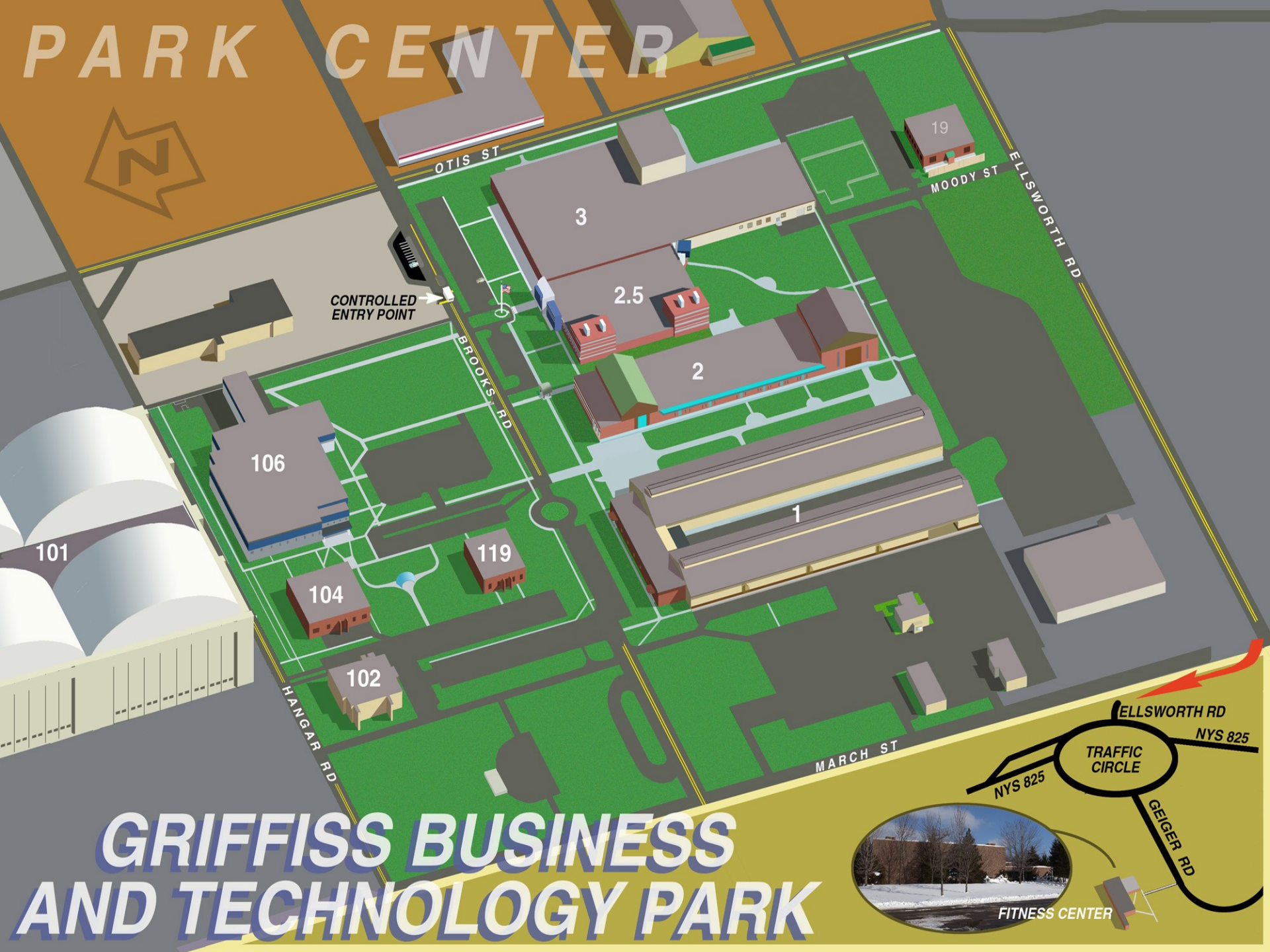


The IF Campus at Rome

- ✓ Supports innovation
- ✓ Encourages collaboration/teamwork
- ✓ Basis for stronger emphasis on In-house work
- ✓ Provides research environment for industry and academic teams



PARK CENTER



CONTROLLED
ENTRY POINT

OTIS ST

MOODY ST

ELLSWORTH RD

BROOKS RD

MARCH ST

HANGAR RD

ELLSWORTH RD
NYS 825

TRAFFIC
CIRCLE

NYS 825

GEIGER RD



FITNESS CENTER

GRIFFISS BUSINESS AND TECHNOLOGY PARK



The Changing Landscape of Warfare



Kinetic Warfare



Characteristics:

Air and Space Vehicles: **UCAVs**

Flight Medium: Air & Space

Weapons: Missiles & Bombs

Desired "Effect": Destroy Target

Control: Air/Space/Ground movement

Low Probability of Intercept: Stealth (Physical)

Low Probability of Detection: Terrain Masking

Homebase: Predetermined Airfield

Logistics: Heavy, Continual

Cyber Warfare



Characteristics:

Cyberspace Vehicles: **Cyber-Crafts**

Flight Medium: Cyberspace

Weapons: Virus, Worm

Desired "Effect": Destroy, Degrade, Co-opt

Control: Network Links that support enemy

Air/Space/Ground movement

Low Probability of Intercept : Stealth (Software)

Low Probability of Detection : Network Masking

Homebase: Any Cyberspace Portal

Logistics: Light, Infrequent (software)

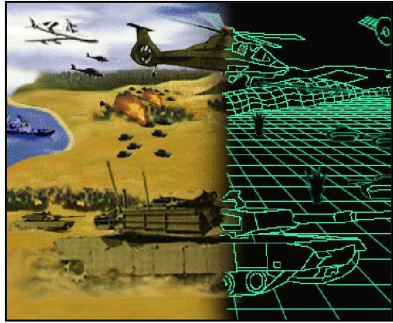
Net result is the same: *IMPEDE THE ENEMY*



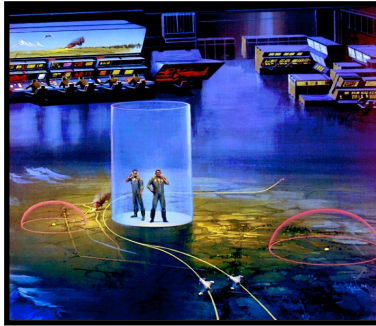
The Changing Landscape of Research



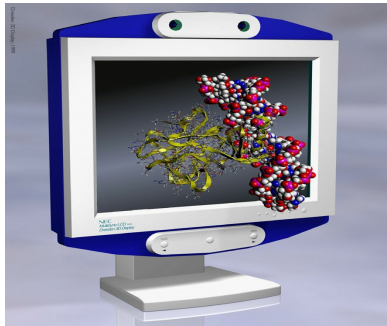
Information Directorate



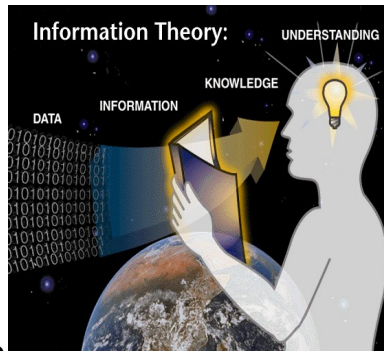
Virtual Worlds



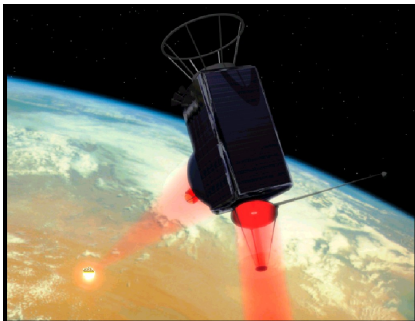
Virtual Presence



Advanced Computing



Cognitive Sciences



IT in Space



Cyber World

BioTechnology

- Bio-inspired Architectures
- *Bacteriorhodopsin* Memory
- Molecular Computing

• NanoTechnology

• Quantum Technology

- Quantum Information Systems
- Quantum Communications

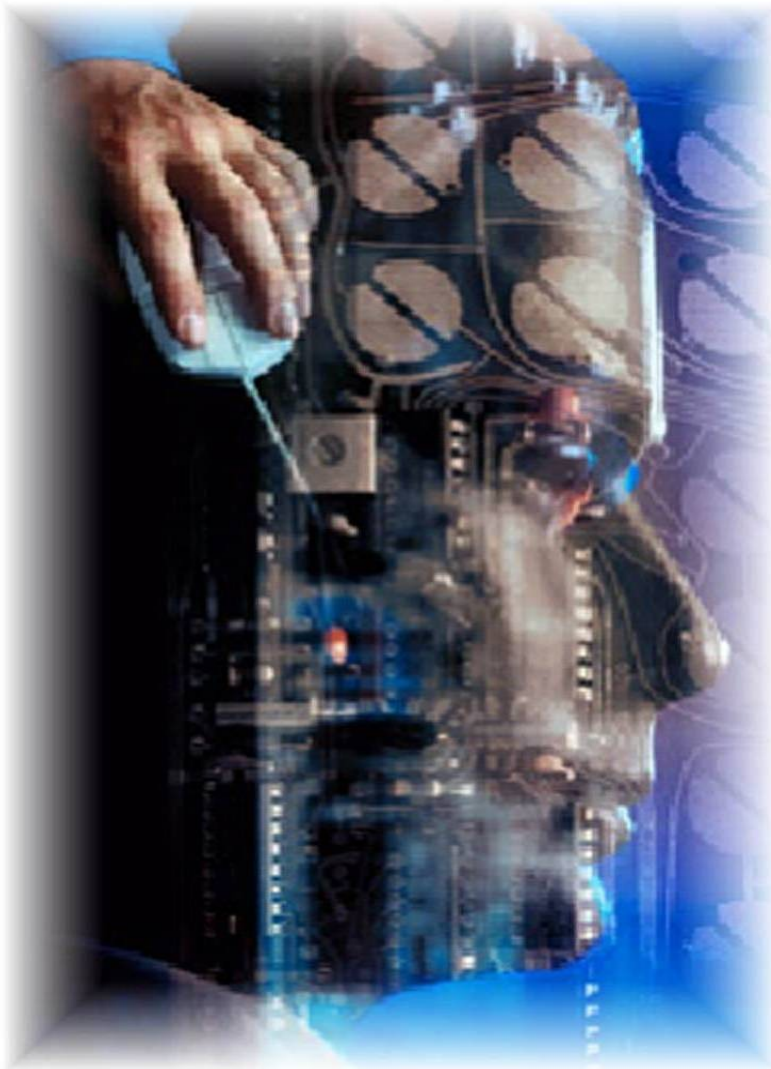


Information Directorate: An Organization on the Move



Information Directorate

- **Addressing Critical Problems for the Air Force and National Defense**
- **Continuously Challenging Technology Foundations**
- **Revitalizing the R&D Space and Intellectual Climate**
- **Attracting Top New Talent from Universities**
- **Building Strategic Partnerships with External Excellence**
- **Moving Advanced Capabilities to the Warfighter via Technology Innovation**



***“The first
essential
of air power
is pre-eminence
in research”***
General H. H. Arnold,
1944

